Shear Capacity of Concrete Beams Reinforced with Continuous Rectangular CFRP Spirals

2013 | MSc Civil Engineering: Innovative Structural Materials

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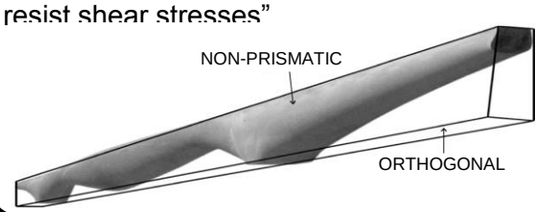
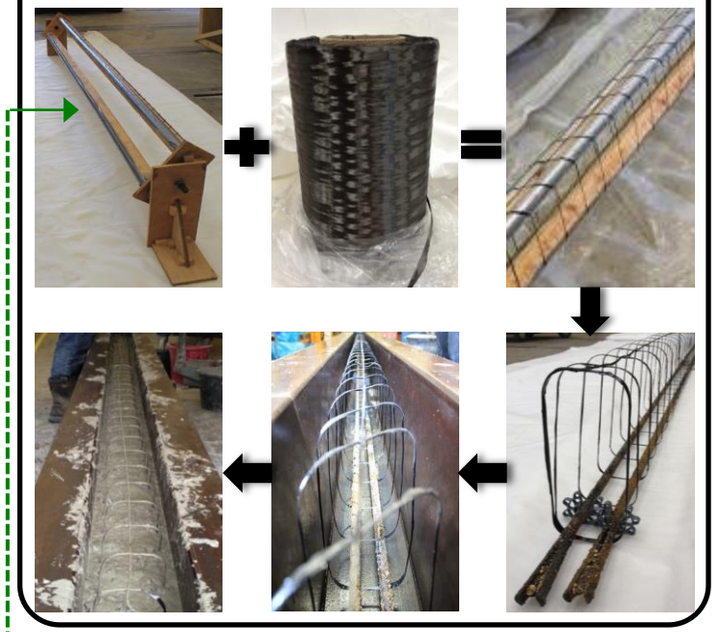
PROJECT AIMS:

"To determine, through theoretical and experimental analysis, the effectiveness and viability of continuous rectangular CFRP (carbon fibre reinforced polymer)spiral cages in concrete beams to resist shear stresses"



"To evaluate techniques to integrate shear reinforcement spirals into non-prismatic, fabric formed beams"

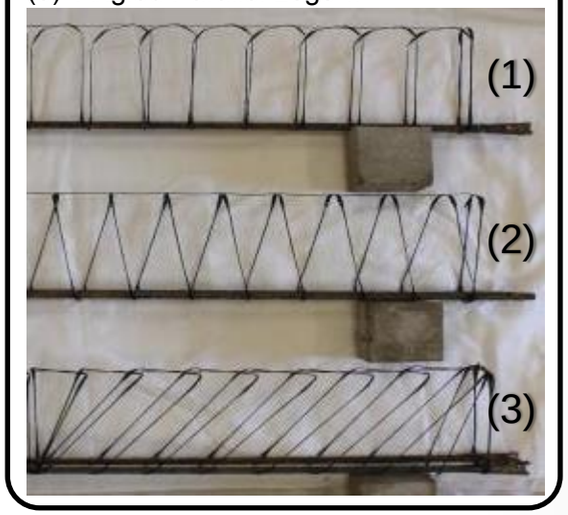
SPIRAL FABRICATION & INSTALATION:



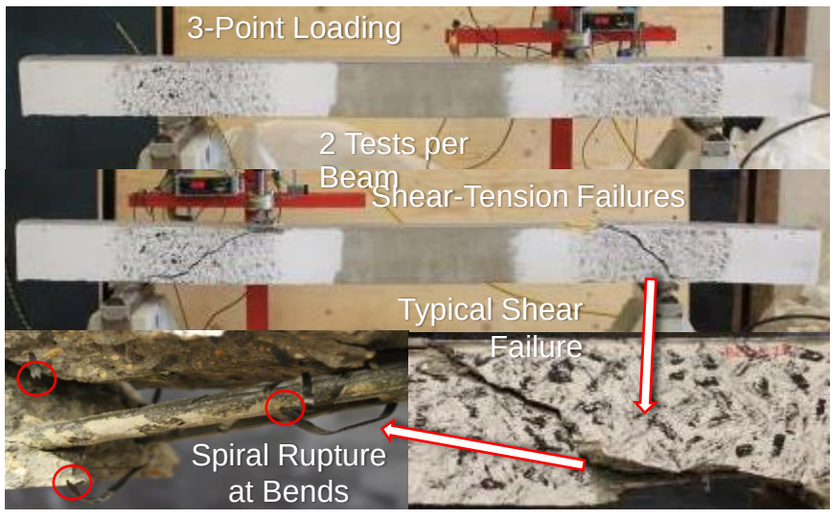
METHODOLOGY:

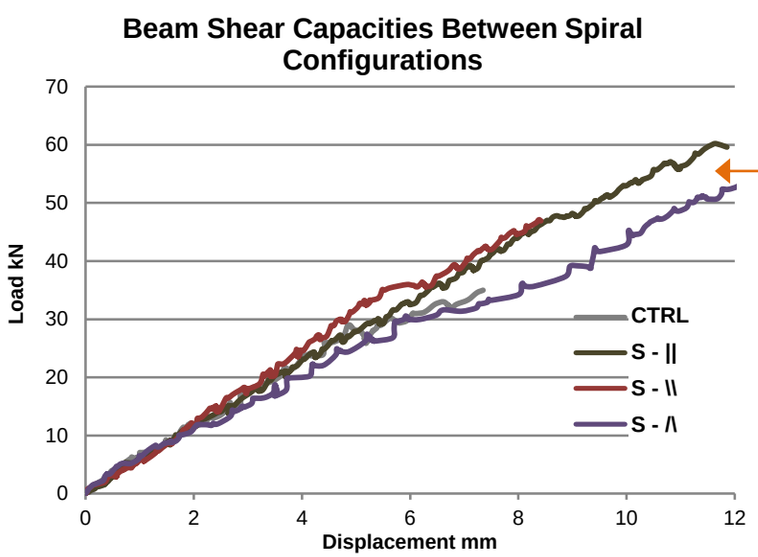
Two spiral spacing's with three CFRP Spiral Cages were fabricated, tested, analyzed, and compared:

(1) Vertical Parallel Legs '||'
(2) Angled Stepped Legs '/\'
(3) Angled Parallel Legs '//'



EXPERIMENTAL RESULTS:





Note: CTRL was the control beam with no transverse (spiral) reinforcement

Beam ID	Shear Capacity Increase due to Spiral [%]	Spiral Shear Capacity Compared to '/\ ' [%]	Actual / ACI 440 Spiral Shear Capacity Ratio
S -		77	38	5.19
S - /\		56	-	3.87
S - \ \		31	-45	1.52

CONCLUSION:

- Spiral cages can be efficiently and effectively fabricated with a filament winding mechanism
- Continuous rectangular CFRP spirals can effectively strengthen concrete beams in shear
- Spiral configuration, '||', was most efficient
- ACI 440 lower bound theorem has major discrepancies in estimating shear capacities of spirals and should be reanalyzed
- Spiral cages to fit non-prismatic fabric formed beams can be fabricated with filament winding mechanisms fitted with non-linear support rods:

Project by Kostova (2013) at the University of Bath